



I do not want my house to be walled in on all sides and my windows to be stuffed. I want the cultures of all the lands to be blown about my house as freely as possible. But I refuse to be blown off my feet by any.

Mahatma Gandhi

Hazards for Skaters and Swimmers

People often retreat to indoor recreational facilities to escape the allergens and pollen of summer, but new evidence shows that the air in such facilities may pose its own threat to respiratory health. Environmental health experts at the Harvard School of Public Health in Boston, Massachusetts, have found that levels of nitrogen dioxide (NO_2) at indoor skating rinks sometimes exceed air quality guidelines set by the World Health Organization (WHO). Another team of researchers monitoring an indoor water park discovered that bioaerosols caused an outbreak of granulomatous lung disease in lifeguards. Both reports appeared in the December 1998 issue of the *American Journal of Public Health*.

A Harvard team led by environmental health researcher Jonathan Levy conducted air quality testing at 19 ice rinks in the Boston area over three winters. They found that concentrations of NO_2 in the rink air correlated with the type of machine used to clean and resurface the ice. At rinks using propane-powered machines, daily mean NO_2 concentrations averaged 206 parts per billion (ppb)—twice as high as the one-hour level recommended by the WHO. In contrast, gasoline-fueled machines produced 132 ppb NO_2 and electric-powered machines produced 37 ppb.

Numerous earlier reports had documented that exposure to elevated NO_2 causes chest tightness, shortness of breath, and other asthma-like symptoms in skaters, hockey players, coaches, and rink employees. "We picked up where those studies left off," says Levy, adding that they next asked, "Given that there are these health problems, how can we reduce NO_2 levels?"

The best solution the researchers found was to replace propane-fueled machines with electric ones. During the course of the study, four ice rinks made the switch and median NO_2 concentrations fell from 124 ppb to 35 ppb. "If [rinks] can economically buy an electric resurfacer, [they should] by all means do it," recommends Levy. However, the \$72,000 price tag for a basic model may be impractical for smaller rinks. Levy found that engineering controls such as increasing ventilation and tuning resurfacers also reduced NO_2 concentrations by an average of 65%.

In another study of an indoor recreational facility, pulmonologist Cecile Rose



Water hazard. Frequent users of indoor swimming and ice-skating facilities may be at risk for respiratory illnesses due to air contaminants including bacteria and nitrogen dioxide.

and colleagues at the National Jewish Medical and Research Center in Denver, Colorado, traced a high incidence of granulomatous lung disease in lifeguards working at a large aquatic center to exposure to contaminated bioaerosols. Granulomatous lung disease results when immune cells cluster in the lungs and form nodules called granulomas in response to an environmental irritant. "Indoor swimming pools have not previously been identified as sources of granulomatous lung disease," says Rose.

The facility Rose investigated had three pools, two waterfalls, numerous spouts and sprayers, two water slides, and bubbler and mushroom fountains. When the waterfalls and mushroom fountain were turned on, the number of respirable aerosol particles (0.45–0.75 micrometers in diameter) rose 1.4-fold above background levels. Adding a water slide caused a 2.3-fold increase. The number of respirable particles rose 5.2-fold when all water features were in use.

Samples of water collected from sprayer features contained large numbers of gram-negative bacteria, predominantly *Pseudomonas* species. In addition, full use of water features raised mean air endotoxin levels from 3.5- to 8-fold, depending on the location of sampling. The water sprayer's design promoted bacterial growth within its circuits, which were severely corroded. During disuse, bacteria multiplied and then were aerosolized in respirable droplets when the machine was turned on.

Among 23 lifeguards working at the facility, 15 were diagnosed with granulomatous lung disease based on lung biopsies and bronchoalveolar lavage. The majority of the affected lifeguards reported work-related cough, shortness of breath, chest

tightness, and upper respiratory congestion. Those diagnosed with the disease worked more cumulative hours and more hours per week than unaffected lifeguards. The researchers have dubbed the newly recognized condition "lifeguard lung."

Patients with granulomatous lung disease generally improve when removed from exposure to the offending contaminant. Oral steroids may be prescribed to reduce inflammation and help restore lung function. Diagnosis of granulomatous lung disease may be complicated by the fact that its symptoms are the same as other common lung disorders, such as asthma, influenza, and bronchitis.

Granulomatous lung disease could occur in users of any indoor swimming pool with water spray features, warns Rose. The frequency of use of an infected pool elevates the risk. For example, she says, "Swim team members who swim daily would be more likely to get granulomatous lung disease than someone who swims once a month."

The Genetic Connection

Every day, it seems, more diseases and conditions are found to be linked to genetic predisposition. On 10 March 1999, the NIEHS sponsored a symposium entitled "Gene–Environment Interactions in Common Clinical Conditions," where participants discussed the gene–environment link in some of today's most common clinical conditions.

Obesity. According to Rudolph Leibel, a professor of pediatrics and medicine at Columbia University in New York City, the heritability of obesity is as high as 80%. While the environment has been implicated